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# Witness and Silence in Neuromarketing: Managing the Gap between Science and Its Application

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## Abstract

Over the past decades commercial and academic market(ing) researchers have studied consumers through a range of different methods including surveys, focus groups, or interviews. More recently, some have turned to the growing field of neuroscience to understand consumers. Neuro-marketing employs brain imaging, scanning, or other brain measurement

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technologies to capture consumers' (brain) responses to marketing stimuli and to circumvent the "problem" of relying on consumers' self-reports. This paper presents findings of an ethnographic study of neuromarketing research practices in one neuromarketing consultancy. Our access to the minutiae of commercial neuromarketing research provides important insights into how neuromarketers silence the neuromarketing test subject in their experiments and presentations and how they introduce the brain as an unimpeachable witness. This enables us conceptually to reconsider the role of witnesses in the achievement of scientific credibility, as prominently discussed in science and technology studies (STS). Specifically, we probe the role witnesses and silences play in establishing and maintaining credibility in and for "commercial research laboratories." We propose three themes that have wider relevance for STS researchers and require further attention when studying newly emerging research fields and practices that straddle science and its commercial application.

**Keywords**

markets/economies, academic disciplines and traditions, methodologies, methods, witness, neuroscience, neuromarketing

**Introduction**

Why do consumers buy what they buy? This question is central for any marketing and advertising professional and has spurred the development of an industry of its own: market research. Traditionally, market research relies on data elicited from consumers employing a diverse set of methods including questionnaires, focus groups, and interviews. This paper presents findings of an ethnographic study of a new practice and field of market research, so-called neuromarketing. Neuromarketing employs brain imaging, and other brain activity measurement technology, as well as biometric methods to capture consumers' (brain) responses to marketing stimuli.

Interest in the application of neuroscience to marketing mirrors the growing attention to the brain over the past two decades (Rose and Abi-Rached 2013). Since President Bush formally designated the period 1990–2000 "the decade of the brain," the number of articles on the topic of neuroscience increased, according to Web of Knowledge, from 44 articles in 1990, to 600 in 2000, to 3,236 in 2016 (see <http://www.loc.gov/loc/brain/proclaim.html>; [www.webofknowledge.com](http://www.webofknowledge.com), accessed October 2017).

These articles derive from various fields, including disciplines such as philosophy, history, religion studies, and economics, which are traditionally unrelated to the neurosciences. To find out how this integration of neuroscience in other fields works out in practice, we studied one of these new neurofields. Neuromarketing is a growing field in academia (there mainly called “consumer neuroscience”) and in the commercial world. The term neuromarketing and the first companies appeared around 2000 and since then the field expanded steadily (Plassmann, Ramsøy, and Milosavljevic 2012). In 2012, the field was established with its own industry association—the Neuromarketing Science and Business Association (NMSBA)—which has 1,684 members from 139 companies, in 93 countries, at the moment of writing (see <http://www.nmsba.com/countries/>, accessed October 2017).

In this paper, we focus on the practices of one specific neuromarketing consultancy, which we refer to as Neuro-X, offering functional magnetic resonance imaging (fMRI) research for commercial market research. Our article is structured as follows. First, we introduce our ethnographic approach to studying neuromarketing practices in general and Neuro-X in particular. Our access to the minutiae of commercial neuromarketing research provides in-depth insights into how neuromarketers silence the neuromarketing subject (i.e., consumer or test subject) in their experiments and presentations and how they introduce the brain as an unimpeachable witness. This enables us conceptually to reconsider the role of witnesses in the achievement of scientific credibility, as prominently discussed in science and technology studies (STS; e.g., Shapin 1984). Next, we consider the role secrets and silences play in neuromarketing to rethink the notion of witnesses in STS. We demonstrate that not only do direct and virtual witnesses play an important role in producing credibility in neuromarketing research, but that secrets and silences can also have important performative effects. Ultimately, we argue that silence and secrecy should not be considered merely as an absence of witnesses in STS. Our study demonstrates that silence can help produce credibility when it allows virtual witnesses to speak on behalf of direct witnesses. We conclude with a discussion of the wider relevance of our study for STS and more broadly for researchers studying newly emerging research fields and practices that span science and its commercial application.

### *An Ethnography of Neuro-X*

In our research, we consider the emergence and development of neuromarketing through a multisited ethnographic research and interview study in

commercial and academic settings involved in neuromarketing. The aim of our study is to explore the role of neuroscientific knowledge, technologies, and practices in the production of authoritative knowledge about consumers and markets. We are specifically interested in the growing prominence of the brain in the context of market research. In our ethnographic research, we have encountered a diverse range of neuromarketing practices in commercial and academic neuromarketing settings including not only the use of neuroscientific technologies such as fMRI and electroencephalography but also the use of so-called biometrics such as eye tracking, facial coding, and heart rate monitoring. Despite the diversity of neuromarketing practices and technologies, members of the laboratories and companies we visited share a relatively consistent understanding of consumers as not having access to their true motives. This conceptualization of consumers is also present in academic publications, professional marketing literature, and media accounts of neuromarketing (Schneider and Woolgar 2012). As some of us have argued elsewhere, this description allows marketers to bypass consumers' accounts and claim to reveal the hidden causes of consumer behavior using neuromarketing (Schneider and Woolgar 2012).

Between 2011 and 2015, we conducted twenty-one semistructured interviews with people (from Europe or the United States) working for neuromarketing companies, conducting academic research in consumer neuroscience, or who were involved in other activities in this field (e.g., writing books, organizing events). The interviews and observations generally took place in the working areas of the interviewees (e.g., scanning centers, companies, universities, conference sites). We observed or participated in seven neuromarketing experiments and had five meetings in which the analysis of the fMRI data or the setup of the experiments was explained. We participated in three courses and three conferences on neuromarketing/consumer neuroscience, and we attended six lectures of neuromarketing companies for a broader audience and/or clients. In addition, we had the opportunity to accompany one neuromarketing consultant to a presentation of the consultancy's services to members of the marketing department of an international consumer goods company. We also collected and analyzed articles in newspapers, magazines, and journals and a neuromarketing year-book (NMSBA 2013).

Following established qualitative data analysis procedures (Miles, Huberman, and Saldana 2014), we analyzed our material (transcripts, field notes, relevant documents) with the computer program Atlas.ti (version 7), which resulted in 180 codes that we clustered into seventeen topics.<sup>1</sup> This gave input for two main themes: "control and subjectivity" and "inside the

algorithm: silence and secrecy” as well as a “rest” category. Corporate secrecy was a main barrier to our attempts at insights into procedures and tools of data analysis in the neuromarketing studies we observed, so we started to wonder how this lack of openness about data analysis (which was also observed on the part of clients, academic researchers, competitors) is related to neuromarketing’s credibility—especially since neuroimaging techniques gain their credibility from the idea of visibility (Baker et al. 2017; Beaulieu 2002).

This paper focuses on a subset of our collected material with the aim to report about the laboratory practices at one specific site—a neuromarketing consultancy we shall refer to as Neuro-X. Since the topic of secrecy spontaneously emerged in most of our material, and since about one-third of our material concerned or was related to Neuro-X (e.g., by mentioning the company), we argue that our ethnographic study of Neuro-X’s research practices provides unique insights into the process of producing knowledge about consumers and their brains using fMRI. That is, we see our case study as an illustrative example of how neuromarketers manage the gap between neuroscience and marketing.

To preserve the anonymity of Neuro-X, we have taken several measures. First, we use a pseudonym for the company and all its members. We have assigned female gender (she) to all persons mentioned in this article, which may or may not reflect the gender of the interviewed/observed person. We also focus exclusively on one neuroscientific method among the different methods that the consultancy employs to prevent identification by the spectrum and combination of methods employed.

Neuro-X is a neuromarketing company in Europe with clients all over the world. In contrast to some other consultancies that preferred to keep their doors closed to external researchers, Neuro-X was very welcoming and allowed us to conduct interviews with five company members, observe during two experiments, and attend four lectures in which the company promoted their research to potential clients or marketing students. We focus on their use of fMRI research. They, for example, test consumers’ brain activity regarding commercials, package designs, or logos, and sometimes, they design and conduct fMRI experiments to answer specific questions of clients (i.e., retail or other companies). Simply explained, such an experiment is designed as follows: a participant is prepared for the fMRI scanner (metal objects removed, body postured with pillows, technology installed), in which he or she views pictures that are supposed to evoke emotional responses (e.g., a spider evokes fear), and the corresponding brain responses are registered under these emotions. Next (or before), the participant is

shown packages, commercials, or other relevant stimuli, and his or her brain reactions are measured and compared with those evoked by the emotional stimuli and related to some benchmarks the company has identified (e.g., for effective commercials) based on prior research. The experiment is normally performed with twenty-four subjects, and often multiple materials (e.g., packages) from multiple clients are tested in one experiment. Clients receive the results of their tested products in the form of scores on emotions, and in this way, they can see that their package design, for example, evokes too much fear in comparison to the company's benchmark for efficacy.

### *From Traditional Market Research to Neuromarketing: Silence the Subject and Enact the Brain*

In neuromarketing presentations, books, websites, and interviews, the use of neuroscientific methods is regularly justified with statements that highlight the ambiguous nature of consumers' accounts. A marketer of Neuro-X, for instance, replicates in lectures and interviews: "Now, we know that what people say is not what they mean" (N2).<sup>2</sup> "Apparently, we just cannot or don't want enough—one of the two—that is, we are not reliable enough" (C5) explains a PhD student in consumer neuroscience. And a professor of neuroscience, working for Neuro-X, claims: "You should never ask people about their intentions. (...) for a long time we know that this hardly says anything about what happens in the market" (N1).

However, historical marketing research demonstrates that this "problem" has actually been the drive of biometrical research in marketing since the start of the twentieth century (Schwarzkopf 2015) and that debates on whether market research should ask consumers directly or indirectly about their motives have existed throughout this period (Henry 1971 as cited in Schwarzkopf 2010). The only new thing about neuromarketing, one could argue, is the claim that it is neuroscience that will reveal the "true motives," the "real intentions," or the "inner" or "essential" truth of the "naked," "unconscious," or "intuitive" consumer (e.g., Genco, Pohlmann, and Steidl 2013; Larson 1994). That is, on the basis of the deep-rooted claim that the voice of the consumer is unreliable, his or her physical brain response is now used as a form of lie detection. As one neuromarketer quoted in a media article put it: "They tell you 'I'm not interested in that' but their medial prefrontal cortex is saying they are" (Blakeslee 2004). And comparable to how brain activity is used as a lie detection, the brain scanner becomes a detector that reveals the real truth about you because it "knows better" (N1) and can predict your behavior (see also Balmer 2015;

Littlefield 2011). As the professor of neuroscience, working for Neuro-X, put it:

You can ask people [something], and they will obediently answer, but it won't say anything about what they do in the shop. Not because people are lying, or because their answers are socially acceptable, (...) the most important reason is: you cannot look into your own brain—and we can. We can look into your brain. That is why a brain scanner knows better what you want, than you do. (N1)

That is, the scanner is introduced as an actor that acts on an indisputable witness—the brain. Moreover, with the help of a scanner, one single brain “speaks” for multiple silenced subjects:

When you ask 1,000 people about their opinion, you get 999 [*different*] answers. When you ask 30 brains about their opinion, this says something about all people that are more or less like them. Our brains do not differ so much. (N1)

This shows that neuromarketing research not only enacts the brain as a more reliable witness than the subject but also presents this witness as speaking for a much larger group of subjects. In the next section, we go more deeply into this idea of witnesses in science, to understand what roles they perform in neuromarketing practices. In addition, we will demonstrate that neuromarketers not only produce witnesses but also have to orchestrate silences in order to achieve a witnessing public.

### *Changing Witnesses*

In her book *The Invention of Modern Science*, Stengers (2000) gives a clear example of the power of witnesses in science. She writes:

whoever doubts the existence of the Sun would have stacked against him or her not only the witness of astronomers and our everyday experience, but also the witness of our retinas, invented to detect light, and the chlorophyll of plants, invented to capture its energy. By contrast, it is perfectly possible to doubt the existence of the “big bang,” for what bears witness to it are only certain indices that have meaning only for a very particular and *homogeneous* class of scientific specialists. (p. 97)

Elaborating on Stengers's ideas, Ashmore, Brown, and MacMillan (2005) use the notion of witness to analyze demarcation and demonstration



techniques in social and clinical psychology. They show that social psychologists produce many reliable witnesses in the form of experimental outcomes, publications, representative scientists, and claims that most people recognize, while clinical psychologists have to work with personal experiences of patients that might be turned into (countable) case studies at the most but will never be recognized by a general public. Hence, clinical psychologists are faced with a greater challenge to demonstrate their expertise than social psychologists.

For Stengers and Ashmore et al., witnesses are mainly representatives of a certain phenomenon: astronomers, retinas and chlorophyll, and experimental outcomes, important scientists, and claims everyone recognizes all help us to believe in the sun or psychological phenomena. Returning to Shapin's (1984) study of the experimental program of natural philosopher Robert Boyle, however, introduces another type of witness. According to Boyle, matters of fact are generated by a multiplication of eyewitnesses. An experience, or experimental performance, witnessed by only one person is not a matter of fact, but when the witness could be multiplied to many, a result could be constituted as an indisputable matter of fact. Reflecting on this, Shapin introduced the notion of "virtual witnesses." Not only should direct observers of an event be seen as witnesses, people who read about the procedures and results of an experiment, and hence make an image of the event in their own mind, can also be understood as witnesses. In this way, the multiplication of witnesses enlarges the "witnessing public" (Shapin 1984). This is further elaborated in Shapin and Schaffer's (1985) book *Leviathan and the Air Pump* where the authors explain how Boyle advocated a set of communication protocols that define adequate scientific reporting. This "literary technology" allows those who are not present during the experiment to become "virtual witnesses" and makes the requirement for direct witnessing or replication less important.

Many more scholars in the field of STS elaborated on the role of (virtual) witnesses, and in these reflections, different kinds of actors such as articles, manuals, photographs, diagrams, and so on came to be understood as vehicles or "immutable mobiles" (phenomena such as maps or books that are moveable but have a stable function and form) that produce virtual witnesses or that function as witnesses themselves (see, e.g., Latour 1987; Latour and Woolgar 1979). In a review of some of these accounts, Woolgar and Coopmans (2006) use the case of "grid technologies" (technological systems for the development of cyberinfrastructures or e-science) to demonstrate that not only is there a distinction between direct witnesses (e.g., direct observers) and virtual witnesses (e.g., readers of the published

experiment) of an actual experiment, but also a distinction between what is often understood as actual (real) information (e.g., raw data) and virtual information (e.g., a graph/conclusion/explanation). That is, apparently, witnesses can move in multiple directions: from “actual experiment” to “direct witness” and from “virtual information” to “virtual witness.” Moreover, witnesses can also have multiple roles: while Stengers and Ashmore et al. introduced witnesses as actors proclaiming evidence (making facts), Shapin and Schaffer presented witnesses as a more passive public (acknowledging facts).

Taking these diverse roles and directions of witnesses into account puts neuromarketing in a slightly different light. To narrow the field of marketing to neuromarketing, the direct witnesses have to change (e.g., from test subjects to brains or marketers to neuroscientists). Furthermore, what is understood as actual information (e.g., responses on questionnaires vs. raw brain data), virtual information (e.g., graphs vs. brain images), and technologies (e.g., questionnaires vs. brain scanners) have to change as well. However, by presenting the brain as a witness that substitutes for thousands of consumer voices, neuromarketers also seem to lose a group of witnesses. After all, many people can follow arguments based upon data derived from questionnaires or focus groups, but it is much more complicated to understand how experts extract consumer insights from the brain. That is, the development from marketing to neuromarketing appears to result in a reduction of the number of direct and virtual witnesses. Neuromarketing is evidenced with fewer participants, the methods and results are understood by fewer people, and the knowledge is less recognizable. This raises the question of how neuromarketers produce credibility for their claims.

To find out how this gap between (neuro)science and its applications is managed by neuromarketers, we studied the activities and strategies of Neuro-X. We demonstrate that neuromarketers have to be “savvy strategists” (Woolgar and Coopmans 2006, 19) who carefully orchestrate their witnesses by making some of them silent and giving others a voice. Rather than considering this secrecy as a barrier to understanding neuromarketing in the making, we follow Rappert’s (2010) suggestion and consider “the potential for the absent.” Based on his research on diplomatic and security communities, Rappert asks “how the highlighting of secrets and absences could be part of efforts to do justice to our understanding of social life” (p. 571). Following his advice on highlighting secrets, we examine in our account the performative effects of secrets.

In this article, we show how neuromarketing relies on witnesses that are not fully open or understood, on clients who are only visible if they can

benefit, and on methods that can never be verified. We will demonstrate that secrets and silences can conceal the information of the actual experiment and let virtual witnesses speak on behalf of the direct witnesses. In this way, we conclude silence and secrecy can produce virtual information that is no longer based upon the actual experiment but on meeting (or exceeding) clients' expectations, for instance, in terms of increased sales or market share.

### *In the Name of Neuroscience*

Neuromarketing companies frequently rely on the idea that emotions can be measured in the brain. However, in our interviews and observations with neuroscientists doing fMRI analyses, this idea was substituted with rather complex explanations about magnetic molecules, statistical tests, computer software programs (C4), and "construct definitions from the outside world" (N3). We found this complex, and so did the neuroscientists ("I hardly understand this myself" (C4); "this is a very complex question" (N3; see also Beaulieu 2001; Cohn 2008). To prevent that all witnesses of neuromarketing disappear in this gap of complexity, many companies have one department for the complex work of data analysis and a separate one to explain the results to clients in comprehensible language.

Similarly, in Neuro-X, the tasks and responsibilities are clearly distributed among different members. The company consists of marketers who explain the neuropart to potential clients, researchers who transform retail questions into experimental designs, fMRI experiment operatives who prepare the participants and make sure they cooperate, and analysts who transform the raw brain data into statistics and into networks that represent emotional or cognitive states. The researchers and marketers then go back to the client to explain the emotion networks and transform it into practical business strategies. All these parties—marketers, researchers, experiment operatives, and analysts—are each accountable for just a small part of the overall study.

The marketing story is simple and straightforward. Although ideas about buy buttons in brains, manipulation of behavior, and predicting effectiveness are critically discussed in and outside the field of neuromarketing and consumer neuroscience (e.g., Kenning 2008), one of the key scientists of Neuro-X makes statements in the media like:

Neuromarketing is about pushing the right buttons in the brain of a consumer. (...) [With neuromarketing tools] it is possible to understand, predict and

hence to manipulate behaviour. (...) With neuromarketing you know exactly beforehand what is effective and what is not effective. (N1)<sup>3</sup>

Besides her work for the neuromarketing company, this scientist is a professor of neuroscience at a top university, and she is nationally known for her lectures, popular scientific books, and newspaper articles on the brain. With her reputation and clear statements, she figures as an expert spokesperson for Neuro-X. In the words of one of our interviewees, a professor of consumer neuroscience, who regularly mentions Neuro-X in her lectures:

[This scientist] visits the management offices. So the whole concept is sold with the idea: “we have a top professor in neuroscience who knows how the brain works (...)” She tells her story and someone else will bring the results. (C1)

Neuro-X is not the only company that mobilizes prominent scientists as expert representatives. Other neuroscientists we interviewed said they would also like to have a top scientist involved in their company. As Ashmore, Brown, and MacMillan (2005) have pointed out, for example, in discussing the role of Elizabeth Loftus as an “expert witness” in the memory wars, distinguished scientists can function as witnesses who justify a claim, or defend a phenomenon, and distribute it via the media to a wider (witnessing) public. That is, having a well-known neuroscientist on board helps to attain scientific credibility for your company.

The “top” scientist of Neuro-X acts as an expert representative of the consultancy in the media, and perhaps she also visits some management offices to convince potential clients. Another member of Neuro-X, working in the company’s marketing and sales team, delivers most of the lectures for marketers, students, and potential clients. In a lecture at a retail conference, she explains:

Effectiveness [e.g., of a commercial] is being based on positive emotions being higher levels than negative emotions [...]. [Some positive] emotions [are] evoked when you want to buy something, and obviously negative emotions must be off. (N2)

When questioned about the use of fMRI in above traditional methods, she answers: “I think the advantage of neuromarketing in general and fMRI in specific is to avoid human mistakes.” And to assure the credibility for this fMRI method, she adds: “fMRI has to be done by hard-core scientists. They

use internationally published facts that are already discovered.” During a master course for business students, critical questions are answered with statements like: “[Scientist N1] is going to publish about that in a few weeks. I don’t know this by heart,” “I will ask [scientist N1] what we will like to share with you,” or simply with: “I am not a scientist” (N2).

In other words, Neuro-X’s marketer delivers a simple story about emotions being high or low and on and off, and she makes it reliable by referring to fMRI machines that cannot make human mistakes<sup>4</sup> and hard-core scientists who make use of internationally published facts. That is, technologies such as brain scanners, emotion graphs, and representative scientists function as witnesses in her neuromarketing account, and for some of these witnesses, it is especially important that they are absent. The absence of “hard-core” scientists (direct witnesses) allows the marketer (a virtual witness) to avoid answering difficult questions, to not reveal the complexity behind fMRI data, and to present the idea of adjustable emotions (virtual information) to students and potential clients (a witnessing public)—all in the name of neuroscience. In other words, making practices not amenable to scrutiny renders them unaccountable to a witnessing public.

### *Neuromarketing in Practice*

The marketers of Neuro-X specialize in evoking interest in potential clients by referring to important scientists, internationally published facts, the expertise of the machine and simplified brain knowledge. But after clients have decided to cooperate with Neuro-X, their main point of contact is with one of the researchers. Depending on the client’s specific question, the researcher fashions a research proposal—sometimes in cooperation with one of the scientists. The researcher then designs the experiment, collects the materials needed, and prepares the input (movies, pictures, etc.) for the scanner.

The experiment itself is carried out by two other people, often students: an assistant of Neuro-X and a scan operator of the scanning center. The scan operator is responsible for the fMRI scans, the assistant of Neuro-X for the visual presentation in the experiment. The assistant explains the experiment to the test subject, makes sure all the necessary forms (medical, informed consent) are completed, and presents the right material at the right moments during the scanning. The operator makes sure that the test subject enters the scanner correctly (no metal, enough pillows, ear plugs), understands what is expected (don’t move, pay attention) and what is allowed (push the alarm

button when you get claustrophobic or have to go to the toilet), and watches the scans and other devices (eye tracker, heartbeat, and respiratory monitor). The operators have to motivate the test subject and make sure that he or she understands the tasks and does not move or fall asleep. That is, they have to make sure that the test-person follows the experimental “script” (Roepstorff and Frith 2004) to ensure that he or she produces the right results. In the words of one of the researchers: “When someone does not understand what he or she should do, or is not focused on the task or the images, the experiment will fail” (N5).

The next step of the study is conducted mainly behind the scenes. The scan results of around twenty-four test persons are sent to one of the scientists who analyses the data. This analyzing process is extremely fast—by contrast with the rather slow process of academic fMRI research in which it can take up to forty hours even to make one scan analyzable, according to a PhD student of consumer neuroscience. Researchers at Neuro-X receive the results back in a few days, in the form of scores on positive and negative states such as trust, attention, or anger. One of the researchers explains: “[We get] results within two days. [Scientist N3]) just has some scripts in SPSS for that” (N5). The scientists confirm this. They describe the complete process as “an automatic pipeline” and the analysis of the fMRI data as working with “scripts” that “automatically generate reports” (N4). The professor of neuroscience explains:

We have identified these networks and we don’t tinker with them anymore. We really defined a pipeline, *a priori*. And that is nice because otherwise it would just take too much time, also because we can now say: this commercial gives this result. (...) So actually it is very much automatized and standardized. (N1)

This routinized process is the crux of what happens in the company. The automatically generated reports do not themselves contain fMRI data but instead provide scores on positive and negative states or emotions. The researchers receive these scores in the form of a web diagram, in which the scores of “ineffective commercials” and “effective commercials” are also visualized. They then need only to interpret these emotion scores in terms of the customers’ questions, make a report, and present the—very clear—results to the customer.

So we see that one of the key strategies of Neuro-X is to divide the tasks and responsibilities in the company. The marketers disseminate the simple neurostory to a wide public of potential virtual witnesses (or clients). To

keep this public interested, they give a voice to important scientists, impeccable machines, pushable brain buttons, and high- or low-level emotions, and they keep silent about fMRI data, moving test subjects, scripts in SPSS, and a priori-defined networks. The researchers give a voice to the clients in the sense—and during the time—that they negotiate about their specific questions and problems. They collect and prepare the materials of the clients for the scanner, and they bring the results in understandable figures and numbers. The experiment operatives give a voice to the test subjects while preparing them for the scanner (they are allowed to ask questions) but also make sure that they are silent during the experiment. And the analytical scientists give a voice to the brain by translating brain data into emotion networks, and their automatic pipeline makes sure that all complex details and processes are backgrounded. So all parties give a voice to some witnesses, while keeping others silenced. Together, they produce one very persuasive visual representation—a spidergram of emotions that everyone understands.

### *The Silence of Neuro-X*

In this spidergram, clients see at a glance what scores their products/campaigns receive, and they can compare this with previous campaigns that were considered likable, annoying, or effective. However, finding out exactly how these diagrams are constructed is not so straightforward. We interviewed scientists, marketers, and experimenters; sent many questions by e-mail; observed during experiments; and attended several lectures in which the company presented their results, and Neuro-X was very cooperative. Yet, always at some point, we ran into a wall of secrecy. The professor, for example, explains:

We show stimuli of which we assume that everyone finds these pleasant or unpleasant and then we extract these networks in the brain that represent these positive or negative emotions. (...) And, yes, what these emotions exactly are, and what kind of networks, and especially what the relation is between these emotions and these networks, and finally human behavior, if they will buy something or not, or if a commercial is effective or not—yes, we keep that for ourselves. (N1)

However, it was not always clear exactly which part of the business was secret. When we asked the company's marketer about this, she answered: "The amount of exposures, the analyses that are built on algorithms, the

filters we use” (N2). One of the scientific analysts told us that she has written a standard manual about what to offer, the amount of stimuli, and so on. But when we asked whether we could have a look at this manual, she firmly answered “no” (N3). We were allowed to observe experiments (and hence could count stimuli), but we were asked to leave the room at the moment they have to “plan the scans.” When we asked the researchers some questions by e-mail, they happily answered—even showed some results—but also added that they hope we treat their answers confidentially. One of the researchers told us that the company has applied for some patents but does not want to mention for what. When we asked the marketer about such patents, she explained: “We have patented a few things—some small parts. But when you patent everything, you also have to open up everything. Just imagine, there could be a Chinese professor [N1] who has this 15 minutes later” (N2).

That is to say, opening up the black box of neuromarketing is not so easy. Those explanations we are given are backed up by a variety of tools in the form of brain scans, emotion networks, important scientists, internationally published facts, and machines that avoid human mistakes and hide a commitment to silence about the methods. Direct witnesses (the operators, researchers, analysts, and test subjects) of the experiments in Neuro-X are only occasionally allowed a voice. And since all methods, procedures, and handouts are secret, Neuro-X does not seem to produce any virtual witnesses either, in the sense of observers of the procedures and results in scientific articles or manuals (Shapin and Schaffer 1985). This raises the question: how does Neuro-X produce a witnessing public?

### *The Credibility of Neuro-X*

Neuro-X isn’t the only marketing company that hides its methods from outsiders: it is not unusual in business to keep your research methods or marketing strategies secret. However, neuromarketers make claims not only about marketing but also about neuroscience, and it is especially their uses of neuroscientific explanations and tools that give their companies a certain status. So we might expect their academic—the consumer neuroscientists who publish their methods and results as part of academic peer-reviewed publication processes—to be the obvious virtual witnesses of companies like Neuro-X. These consumer neuroscientists also circumvent the human voice and instead search for the correlation between neural activity and consumer behavior. Since they know how to reproduce the experiments and verify the methods and results of a neuromarketing company, they



could be reliable and powerful allies. However, our interviews with consumer neuroscientists, and our attendance at courses and lectures in this field, suggest that they are actually somewhat skeptical about the methods and results of Neuro-X and other neuromarketing companies. They point out that these companies do not publish (academically) or otherwise reveal their methods, and so they are doubtful about the reliability of their commercial colleagues. Moreover, some academics call for a program of “evidence-based neuromarketing” (Smidts et al. 2014, 265). This skepticism also comes to the fore in a master’s course on neuromarketing where the professor in consumer neuroscience discusses a lecture by Neuro-X with her students:

Yes, sometimes I also wonder; what do they know that we don’t? (...) You don’t know how they measure a response. They link the brain to observation but they never show how. You simply have to take their word for it. (...) But maybe they have solved it. If they can distinguish these emotions they have something.” (C1)

Comparable evaluations are expressed by some PhD students in consumer neuroscience who argue, for example: “You simply don’t know if it is not very much exaggerated” (C4), “Why don’t we find that and they do?” (C4), or “You can’t control what they are doing because their methods are secret” (C3).

In an interview, the professor expresses her doubts about the credibility of the company: “We don’t know for sure [if their methods work]. They are a bit loose with their *p*-values. They dare to show results with a  $p = 0.20$ , which means that one of every five answers is not based on anything, but you don’t know which one. In my opinion, that is over-claiming” (C1). She also brings in the position of the clients and actually gives them the role of witnesses:

A client does not want to hear: “we don’t know if a is better than b,” so [*they*] say: “a is better than b.” From a scientific point of view this is irresponsible, but clients do accept it. [... *However* ...] clients probably want to test different methods [*at other companies*], and finally they will have material to compare. So we will see if this really has an added value for them. (C1)

In other words, since neuromarketing companies do not want to publish their methods, consumer neuroscientists actually have little insight into what these companies are doing. Consumer neuroscientists, with their

academic expertise and knowledge, are silenced because they can only guess what exactly happens in such companies. Yet this silencing of very strong potential witnesses does not seem to harm these companies. Part of this may be because potentially critical questions and comments like: "Why don't we find that?," "Maybe they have solved it," or "we will see if this really has an added value for them [*clients*]" can also be understood as expressing a certain curiosity on the part of consumer neuroscientists. Some of them find ways of engaging with neuromarketers during conferences, contacting them directly by e-mail or enter into collaborations. These exchanges, engagements, or entanglements have the potential to create additional witnesses. However, it is likely that these witnesses are silenced by nondisclosure agreements or encounter walls of secrecy similar to the silences we encountered in our ethnographic research. Despite academic collaborators being silenced (or encountering silences), we wonder whether there is a sense in which we ourselves count as witnesses since we have seen (some) of the doing of neuromarketing as presented in this paper. Perhaps our own effort at studying neuromarketing practices inevitably co-constitutes them. At the same time, our attempts to maintain anonymity further add to the silences of neuromarketing. So the direct witnesses of neuromarketing may still bear a certain potential for producing credibility despite acknowledging silences, limited access, and unresolved questions, if they bring a certain academic or organizational credibility to the collaboration in the first place.<sup>5</sup>

### *Case Studies as Evidence*

The results of neuromarketing companies cannot be (scientifically) validated but can only be evaluated by clients. However, making contact with neuromarketing clients is hindered by privacy considerations. Although some neuromarketing consultancies put case studies or brand names (e.g., Coca-Cola, McDonalds, Unilever, BBC, GlaxoSmithKline) on their websites, occasionally mention them to journalists, at industry conferences, or in their (trade press) publications, they maintain their clients' anonymity.

Despite such privacy and secrecy rules, we managed to retrieve some (fMRI) case studies of neuromarketing clients of Neuro-X or other fMRI marketing studies. At a meeting for executives of different companies where Neuro-X was asked to give a guest lecture (and we were invited to join), we talked to an executive of a bank who told us that they had once hired a neuromarketing company to use fMRI to test whether their reputation was damaged and whether they should change their logo or their

advertisement. The fMRI research demonstrated that their reputation was not too much damaged and that a new campaign would not be very helpful. This was valuable information for the bank because otherwise they would have spent a lot of money to set up a new campaign.

In a competition for a media communication award, Neuro-X presented a case study to the audience (of which we were part) together with one of their clients: a public broadcaster of radio and television commercials. The public broadcaster wanted to prove its added value above commercial broadcasting companies. They had not achieved the desired answers with traditional research. The fMRI research, however, did prove their added value, and hence they use the fMRI results to promote the idea that commercials in between programs are more effective than commercials that interrupt programs—as a sort of advertisement for their own company. In an annual report, they write that “Unique brain research of [the broadcast company] and [Neuro-X] proves that the many years of contact with the quality programs of the national channels, resulted in a consequent positive impact on commercials broadcasted in this public environment.”

In another example, a creative agency and Neuro-X worked closely together on a popular car commercial. The commercial is partly filmed in a neuroimaging center, and the professor of neuroscience (N1) figures as a scientist conducting fMRI scans. We see (raw) fMRI scans, the eye of the (assumed) test-person, and a driving car. We hear the sounds of the car, and a voice-over concludes: “Your brain expects the same satisfaction from [this car] as it does from addictive things.”

So, while most clients of neuromarketing companies are a well-kept secret—neuromarketing companies are not allowed to reveal their names, and this problem of secrecy is also much discussed at neuromarketing conferences—other clients use the (positive) results of neuromarketing companies to promote their own brand or company. In this case, neuromarketing clients can turn into very strong witnesses. Not only because they represent one of the rare case studies, but also because they actively disseminate this success story in their own networks, for example, to prove that they are “really” better than their competitors.

That is to say, when clients of neuromarketing companies become salient, they are often in an interactive relationship with the company: the brand and the neuromarketing company reinforce each other (see also Andrejevic 2012). In this interaction, however, the “neuro” part of neuromarketing is not always completely clear. Although the brain is sometimes brought up as evidence for a claim (in the form “brain research proves . . .”), it is especially the practical results in terms of clients, money, and reputation that are

brought to the fore. That is, the brain is present but its role is not fully explained. It has become backgrounded, but nevertheless, figures as a very strong witness that can testify for many sorts of evidence. This phenomenon—simply referring to the brain makes a statement appear more real, objective, or effective in the eyes of the public—has become known as “neurorealism” among (critical/social) neuroscientists (Illes et al. 2010; O’Connor, Rees, and Joffe 2012; Racine, Bar-Ilan, and Illes 2005). In the world of neuromarketing, this mechanism is very obvious. In many lectures, books, and blogs, the brain simply substitutes for the consumer or seems not to add any relevant information at all (e.g., “why brains buy”; Pradeep 2010 cited in Andrejevic 2012). And in some cases, such as the broadcasting company and the car manufacturer, this effect is so strong that the brain is used as a marketing tool—a witness that “proves” that you are better than your competitor.

## **Conclusion**

In this paper, we have questioned how it is possible that neuromarketing companies produce a witnessing public in the form of clients and media attention, while the actual experiments all occur behind the scenes and are not, or not completely, published. We argue that the described silences help to sustain neuromarketing’s promises. Consumer neuroscientists are unable to verify the analysis of neuromarketing companies because of their secrecy. Clients do not understand the methods of these companies and, moreover, they cannot be approached because of their anonymity. Hence, the only knowledge we can retrieve is based on what neuromarketers decide to share. Neuromarketing companies decide which witnesses are allowed to speak and which actors should be silenced. For instance, consumers (who figure as research subjects) in neuromarketing research practice are denied a voice in the form of a self-report on their consumption preferences. The consumers’ brain is “interviewed,” measured, rendered visible, and analyzed instead. Marketers and researchers talk on behalf of neuroscientists about positive and negative emotions but are silent about the uncertainties or difficulties of fMRI research. Neuroscientists can talk about fMRI data, computer scripts, and statistical tests, but the ins and outs of their methods and automatic pipelines are corporate secrets. Research operatives talk with the subjects and make sure they behave during the scan as silent, motionless, but attentive brains. Clients are silent because of anonymity—until the moment that they decide to speak up which is basically when they can use neuromarketing to advance their own marketing strategies.

Rather than considering this secrecy as a barrier to understanding neuromarketing in the making, we follow Rappert's (2010) advice on highlighting secrets. In our account of neuromarketing, we examine the effects of secrets—in particular the silence of direct witnesses in the case of Neuro-X. Returning to Woolgar and Coopmans (2006) helps to understand why these absences of (speaking) witnesses appear to have a positive effect on the field of neuromarketing. In their attempt to understand the connections between the deployment and the subsequent success of a technology, Woolgar and Coopmans concluded there is not only a distinction between the actual experiment and its virtual information (e.g., in publications) but also between what is *understood* as actual and virtual information. Applying this to the case of neuromarketing, we conclude that since the direct witnesses in a neuromarketing experiment are silenced, there is no actual information to be verified. Hence, it is not the transformation from consumers' preferences to brain responses that is understood as the transit from real to virtual; nor the translation from raw brain data into visualized emotion networks; nor the transfer from emotion networks to advertising strategies. If neuromarketing solely relies on the approval of clients, the "actual" experiment is whether the neuromarketing advice corresponds to what these clients expect or want. In other words, the executive of the bank receives the message that the reputation of the bank is not damaged too much and is satisfied because it gives a "validated" reason not to start a new campaign. The broadcasting company is happy because the outcomes of the neuromarketing study perfectly fit their marketing strategy. And the creatives of the car commercial used neuromarketing and the brain as witnesses to prove the success of the car. These clients give credibility to neuromarketing, while in none of these cases is the efficacy of neuromarketing proved or disproved. Clients take the results, are happy with these or not, but they will never find out what would have happened if the study would have given a different outcome.

Our case study demonstrates that silence can help produce credibility when it allows virtual witnesses to speak on behalf of direct witnesses, and hence, that silence and secrecy can produce virtual information that is no longer based upon the actual experiment but on what clients expect or want. Drawing on these findings, we conclude by proposing three themes that we consider central for STS researchers studying newly emerging research fields and practices that straddle science and its commercial application. First, we surmise that comparative studies of different groups and group identities (as in our case the neuromarketers vs. consumer neuroscientists) in newly emerging research fields will allow for an initial identification of tensions in managing science and its application beyond academic basic

research. Second, we suggest that STS scholars attend to the performative effects of silence particularly in “nontraditional” or “hybrid” research settings such as commercial research laboratories. This enables further elaboration both of the effects of secrets in the business context (and the potential these have for making new markets) and of the likely negative effects (e.g., public distrust) these could have on the underlying area of scientific study. This is particularly important at a time when calls for research impact and the commercialization of science are redefining “scientific life” (Shapin 2008) and compelling scientists to demonstrate their research’s business potential and when the public’s distrust of science is increasing. Third, we propose that in trying to understand collaboration among different members of commercial research laboratories (and advisors, external collaborators, etc.), greater emphasis should be given to the in situ study of how silences are generated and maintained and how they are not turned into an issue in collaboration. Our understanding of this silence about silences (the elephant in the room), what we might call the achievement of “nonissuefication,” could usefully supplement and extend existing STS research on “trading zones”<sup>6</sup> (Galison 1997) by studying how collaboration can be achieved despite not finding a common scientific language.

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### **Notes**

1. The seventeen topics were relation neuromarketing-academia, brain manipulation, technologies, professionalism-amateurism, advertising as science or art,

human-machine, objectifying the subject, creating the human brain with functional magnetic resonance imaging, money, secrecy of methods, effectiveness, backgrounds of neuromarketers, tacit knowledge, neuro versus marketing, process from idea to publication, men-women, and trends and developments.

2. Acronyms stand for: N = Neuro-X, C = consumer neuroscientist. Numbers stand for the sequence of the interviewees in this group.
3. This is a quote from the Internet. To keep the company anonymous, we do not cite the exact link.
4. This is a questionable claim. See, for example, Vul et al. (2009), Stelzer et al. (2014).
5. This issue of reflexivity was also addressed in one of our previous papers (Schneider and Woolgar 2015).
6. Galison (1997) uses the concept of the “trading zone” to explain how engineers and physicists with different backgrounds/paradigms managed to collaborate and to develop particle detectors and radar.

## References

- Andrejevic, Mark. 2012. “Brain Whisperers: Cutting through the Clutter with Neuromarketing.” *Somatechnics* 2 (2): 198-215.
- Ashmore, Malcolm, Steven D. Brown, and Katie MacMillan. 2005. “Lost in the Mall with Mesmer and Wundt: Demarcations and Demonstrations in the Psychologies.” *Science, Technology, & Human Values* 30 (1): 76-110.
- Balmer, Andrew S. 2015. “Telling Tales: Some Episodes from the Multiple Lives of the Polygraph Machine.” In *Knowledge, Technology and Law*, edited by Emilie Cloatre and Martyn Pickersgill, 104-18. London, UK: Routledge.
- Baker, D. A., Jilian M. Ware, N. J. Schweitzer, and Evan F. Risk. 2017. “Making Sense of Research on the Neuroimage Bias.” *Public Understanding of Science* 26 (2): 251-58.
- Beaulieu, Anne. 2001. “Voxels in the Brain Neuroscience, Informatics and Changing Notions of Objectivity.” *Social Studies of Science* 31 (5): 635-80.
- Beaulieu, Anne. 2002. “Images Are Not the (Only) Truth: Brain Mapping, Visual Knowledge and Iconoclasm.” *Science, Technology, and Human Values* 27 (1): 53-86.
- Blakeslee, Sandra. 2004. “If Your Brain Has a ‘Buy Button,’ What Pushes It.” *The New York Times*, October, 19. Accessed September 2018. <https://www.nytimes.com/2004/10/19/science/if-your-brain-has-a-buybutton-what-pushes-it.html>.
- Cohn, Simon. 2008. “Petty Cash and the Neuroscientific Mapping of Pleasure.” *BioSocieties* 3 (2): 151-63.
- Galison, Peter. 1997. *Image & Logic: A Material Culture of Microphysics*. Chicago, IL: Chicago University Press.

- Genco, Stephen, Andrew Pohlmann, and Peter Steidl. 2013. *Neuromarketing for Dummies*. Mississauga, ON: John Wiley.
- Illes, Judy, Mary Anne Moser, Jennifer B. McCormick, Eric Racine, Sandra Blakeslee, Arthur Caplan, and Erika Check Hayden, et al. 2010. "Neurotalk: Improving the Communication of Neuroscience Research." *Nature Reviews Neuroscience* 11 (1): 61-69.
- Kenning, Peter. 2008. "What Advertisers Can Do and Cannot Do with Neuroscience." *International Journal of Advertising* 27 (3): 472-73.
- Larson, Erik. 1994. *The Naked Consumer: How Our Private Lives Become Public Commodities*. London, UK: Penguin.
- Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.
- Latour, Bruno, and Steve Woolgar. 1979. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.
- Littlefield, Melissa M. 2011. *The Lying Brain: Lie Detection in Science and Science Fiction*. Ann Arbor: University of Michigan Press.
- Miles, Matthew B., Michael A. Huberman, and Johnny Saldana. 2014. *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, CA: Sage.
- NMSBA (Neuromarketing Science and Business Association). 2013. *Neuromarketing Yearbook 2013*. Venlo, the Netherlands: Neuromarketing Science and Business Association.
- O'Connor, Clíodhna, Geraint Rees, and Helene Joffe. 2012. "Neuroscience in the Public Sphere." *Neuron* 74 (2): 220-26.
- Plassmann, Hilke, Thomas Z. Ramsøy, and Milica Milosavljevic. 2012. "Branding the Brain: A Critical Review and Outlook." *Journal of Consumer Psychology* 22 (1): 18-36.
- Racine, Eric, Ofek Bar-Ilan, and Judy Illes. 2005. "fMRI in the Public Eye." *Nature Reviews Neuroscience* 6 (2): 159-64.
- Rappert, Brian. 2010. "Revealing and Concealing Secrets in Research: The Potential for the Absent." *Qualitative Research* 10 (5): 571-87.
- Roepstorff, Andreas, and Chris Frith. 2004. "What's at the Top in the Top-down Control of Action? Script-sharing and 'Top-top' Control of Action in Cognitive Experiments." *Psychological Research* 68 (2-3): 189-98.
- Rose, Nikolas, and Joelle M. Abi-Rached. 2013. *Neuro: The New Brain Sciences and the Management of the Mind*. Princeton, NJ: Princeton University Press.
- Schneider, Tanja, and Steve Woolgar. 2012. "Technologies of Ironic Revelation: Enacting Consumers in Neuromarkets." *Consumption, Markets & Culture* 15 (2): 169-89.



- Schneider, Tanja, and Steve Woolgar. 2015. "Neuromarketing in the Making: Enactment and Reflexive Entanglement in an Emerging Field." *BioSocieties* 10 (4): 400-421.
- Schwarzkopf, Stefan. 2010. "Ernest Dichter Motivates the British: Motivation Research and Contested Professional Legitimacies in Britain." In *Ernest Dichter and Motivation Research*, edited by Stefan Schwarzkopf and Rainer Gries, 220-35. London, UK: Palgrave Macmillan.
- Schwarzkopf, Stefan. 2015. "Measurement Devices and the Psychophysiology of Consumer Behaviour: A Posthuman Genealogy of Neuromarketing." *BioSocieties* 10 (4): 465-82.
- Shapin, Steven. 1984. "Pump and Circumstance: Robert Boyle's Literary Technology." *Social Studies of Science* 14 (4): 481-520.
- Shapin, Steven. 2008. *The Scientific Life. A Moral History of a Late Modern Vocation*. Chicago, IL: Chicago University Press.
- Shapin, Steven, and Simon Schaffer. 1985. *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life*. Princeton, NJ: Princeton University Press.
- Smidts, Ale, Ming Hsu, Alan G. Sanfey, Maarten A. S. Boksem, Richard B. Eibstein, Scott A. Huettel, Joe W. Kable, et al. 2014. "Advancing Consumer Neuroscience." *Marketing Letters* 25 (3): 257-67.
- Stengers, Isabelle. 2000. *The Invention of Modern Science*. Minneapolis: University of Minnesota Press.
- Stelzer, Johannes, Gabriele Lohmann, Karsten Mueller, Tilo Buschmann, and Robert Turner. 2014. "Deficient Approaches to Human Neuroimaging." *Frontiers in Human Neuroscience* 8: 462.
- Vul, Edward, Christine Harris, Piotr Winkielman, and Harold Pashler. 2009. "Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition." *Perspectives on Psychological Science* 4 (3): 274-90.
- Woolgar, Steve, and Catelijne Coopmans. 2006. "Virtual Witnessing in a Virtual Age: A Prospectus for Social Studies of E-science." In *New Infrastructures for Knowledge Production: Understanding E-science*, edited by Christine Hine, 1-25. Hershey, PA: Idea Group.

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